Carleton UNIVERSITY | Department of Systems and Computer Engineering

SYSC4906: Introduction to Data Science & Data Visualization

Instructor

Fateme Rajabiyazdi

How to address me: Professor Rajabi

Email: fateme.rajabiyazdi@carleton.ca

Office hours: By appointment

TA

Shri Harini Ramesh

Email: shriharinirامesh@cmail.carleton.ca

Calendar description

In this course, we will introduce a wide overview of the main concepts in data science and data visualizations for beginners. We will introduce a set of preliminary tools and techniques for analyzing and visualizing data.

By the end of the course, students will learn the basics of the different properties of data (structure, size, and type) and will be able to categorize data based on their properties. They will also gain an introductory level understanding of analytical techniques that will allow them to infer insights from data. Students will learn data analytics and data visualization methodologies and will be able to choose and evaluate methods that are appropriate for answering a given question. This course is not intended to cover all principles of data science and data visualization in detail.

Lectures: 2x1.5hr/week, Lab/problem analysis: 3hrs/week

Prerequisites

SYSC2006 (with a minimum grade of C-), and third-year status in Engineering.

Prior knowledge

Students should:

- understand basic statistical concepts,
- be proficient in software development in at least one language,
- be able to program in Python or learn to do so on their own time within the first few weeks of class.

Learning outcomes & course objectives

By the end of this course, students should be able to:

- Explain the different properties of data (structure, size, and type)
- Collect, clean, and process data
- Analyze data using data analysis techniques and tools
- Critically and constructively assess the design of existing visualizations based on visualization theory and principles.
- Design and develop effective visual presentations of data for exploration and communication

List of Topics

• Data Science project lifecycle and data scientists' toolbox
• Data Collection
• Data Preparation
• Descriptive Statistics
• Data Visualization
• Basics of Artificial Intelligence and Machine Learning
• Reporting Results
• Data Ethics

Graduate Attributes (GAs)

The Canadian Engineering Accreditation Board requires graduates of engineering programs to possess 12 attributes at the time of graduation. There are no GA's related to this course. For more information, please visit: https://engineerscanada.ca/.

Textbook (or other resources)

The following textbook is recommended (optional):

- Skiena, Steven S. The Data Science Design Manual. 1st ed. 2017. Springer International Publishing, 2017. Free eBook: https://www.webpages.uidaho.edu/~stevel/517/The%20Data%20Science%20Design%20Manual.pdf
- Visualization Analysis and Design, Munzner, Tamara, A K Peters, Limited, 2014. Free eBook available at Carleton University Library.

Evaluation and Grading scheme

Element	Notes	Grading Scheme
Datathon	Students must complete 10 Datathons in the lab.	50%
Midterm	Students must obtain at least 50% in the midterm (proctored) to pass the course.	20%
Class participation	For full marks, students must attend all guest lectures.	5%
Final project	Students must complete 3 deliveries for the final project individually.	25%

Midterm Exam format and e-proctoring

Engineering Courses shall have on campus and proctored examinations. The exam may be in electronic format (i.e. Student will write the exam on campus and use either their computer or a university-owned computer).

e-Proctoring: Please note that tests and examinations in this course will use a remote proctoring service provided by Scheduling and Examination Services. You can find more information at https://carleton.ca/ses/e-proctoring/.

Note: Students must obtain at **least 50% on the midterm** to pass the course.

Self-Declaration form and Deferred Term work

Calendar language (Section 4.4 https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/examinations/#deferred-term-work):

Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases this must occur no later than three (3) days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule.

Consult with the instructor no later then 3 days after any missed course work or midterm examination.

Breakdown of Course Requirements

Lectures
Lectures will be delivered **in-person synchronously**. Note that students must be available at times scheduled for lectures and presentations.

Labs (Datathon*)*: (50%)
Labs will be delivered **in-person synchronously**. Note that students must be available at times scheduled for labs. Labs will focus on hands-on activities.
Datathons in this course should be completed in groups of 5 students.

Midterm Exam (in-class): (20%)
The midterm exam will be conducted during the class period on Brightspace. Exam will be proctored. Please note that the examinations in this course will use a **remote proctoring service** provided by Scheduling and Examination Services. You can find more information at https://carleton.ca/ses/e-proctoring/

Class Participation - Guest lectures: (5%)
For full marks, students must attend all guest lectures. Information about the guest lectures will be announced on Brightspace.

Final Project (Individual): (25%)
The project work required in this course should be completed **individually** and it will be divided into three components:

- ***Delivery#1:*** *(2-page report) Clean dataset, report analysis (10%)*
- ***Delivery#2:*** *(3-min presentation) Demo and presentation, data visualization (5%)*
- ***Delivery#3:*** *(2-page report) Report on the final visualization and analysis (10%)*

Tentative Week-by-Week Breakdown

Week #	Content
Week 1	• Intro to Data Science • Data Collection
Week 2	• Data Storage • SQLite
Week 3	• Data Cleaning • Open Datasets
Week 4	• Data Integration • Data Science Buzzwords
Week 5	• Bias • Data Visualization, Graphs and Data Presentation
Week 6	• Intro to Statistics • Statistical Errors
Week 7	Reading Week

Week 8	• Professional Development • Midterm
Week 9	• Correlation • Regression • t-test
Week 10	• Dimension Reduction • Regression
Week 11	• Clustering • Classification
Week 12	• Data Ethics
Week 13	• Text Data • NLP Techniques
Week 14	• Project Presentations

Copyright

Advising and Counselling Services

a) Engineering Academic Advising

The Engineering Academic Support Service: https://carleton.ca/engineering-design/current-students/undergrad-academic-support/ assists undergraduate engineering students with course selection, registration, and learning support from first-year through to graduation.

Academic Advisors Contact: https://carleton.ca/engineering-design/current-students/undergrad-academic-support/undergraduate-advisors/

b) Student Mental Health Service

As a University student you may experience a range of mental health challenges that significantly impact your academic success and overall well-being. Carleton's Wellness Services Navigator https://wellness.carleton.ca/navigator/ is designed to help students connect with mental health and wellness resources. If you need to talk to someone, please reach out for assistance: https://carleton.ca/health/emergencies-and-crisis/.

Learning and Working Environment

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the Department of Equity and Inclusive Communities at equity@carleton.ca

We will strive to create an environment of mutual respect for all through equity, diversity, and inclusion within this course. The space which we work in will be safe for everyone. Please be considerate of everyone's personal beliefs, choices, and opinions.

Academic Integrity and Plagiarism

a) Please consult the Faculty of Engineering and Design information page about the Academic Integrity policy and our procedures: https://carleton.ca/engineering-design/current-students/fed-academic-integrity Violations of the Academic Integrity Policy will result in the assignment of a penalty such as reduced grades, the assignment of an F in a course, a suspension or, expulsion.

b) One of the main objectives of the Academic Integrity Policy is to ensure that the work you submit is your own. As a result, it is important to write your own solutions when studying and preparing with other students and to avoid plagiarism in your submissions. The University Academic Integrity Policy defines plagiarism as "presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own." This includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source.

Examples of violations of the policy include, but are not limited to:
· any submission prepared in whole or in part, by someone else;

· Using another's data or research findings without appropriate acknowledgement;

· Submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own;

· Failing to acknowledge sources of information through the use of proper citations when using another's work and/or failing to use quotations marks; and

· Unless explicitly permitted by the instructor in a specific course, the use of generative AI and similar tools to produce assessed content (such as text, code, equations, images, summaries, videos, etc.).

Academic Accommodations

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For accommodation regarding a formally-scheduled final exam, you must complete the Pregnancy Accommodation Form (click here).

Religious obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details click here.

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).

Survivors of Sexual Violence: As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/equity/sexual-assault-support-services

Accommodation for Student Activities: Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation will be provided to students who compete or perform at the national or international level. Write to me with any requests for

academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf